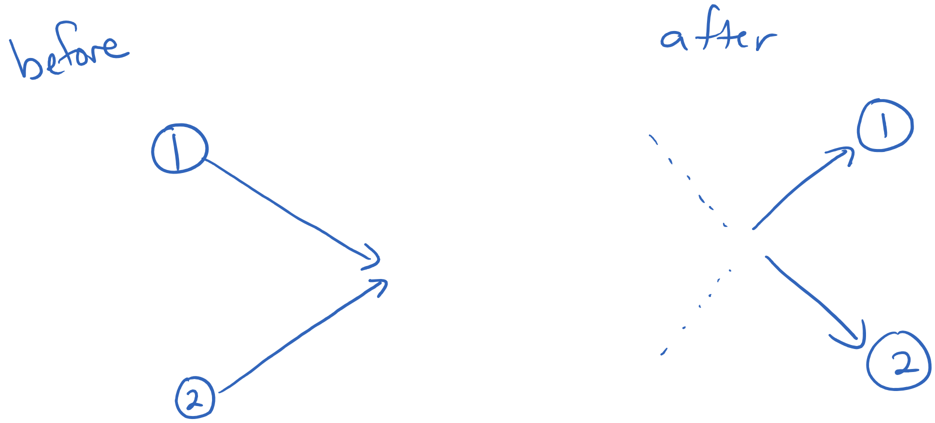
Momentum: 2-D Collisions

October 18, 2017 10:57 AM

Some collisions are non-linear



Note

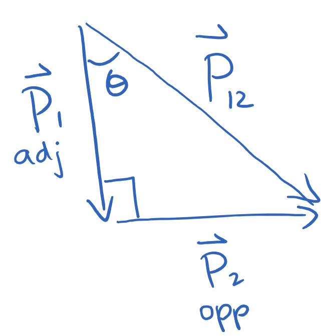
If collision is perfectly elastic (both p and E_k are conserved) and the objects are the same mass, then the angle after the collision will always be $90°$ (unless linear of course)

Example 1

before: ① 4 kg, 2.8 m/s [S] + ② 6 kg, 3 m/s [E] | after: (1+2) 10 kg, $v = ?$

$$\vec{P}_1 + \vec{P}_2 = \vec{P}_{12}$$

but must use vector addition since no linear



$$(\vec{P}_{12})^2 = (\vec{P}_1)^2 + (\vec{P}_2)^2$$

$$(m_{12}\vec{V}_{12})^2 = (m_1\vec{V}_1)^2 + (m_2\vec{V}_2)^2$$

$$(10\vec{V}_{12})^2 = (4 \cdot 2.8)^2 + (6 \cdot 3)^2$$

$$10\vec{V}_{12} = \sqrt{11.2^2 + 18^2}$$

$$\tan\theta = \frac{opp}{adj}$$

opp

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$= \frac{\vec{P}_2}{\vec{P}_1}$

$\theta = \tan^{-1}\left(\frac{18}{11.2}\right)$

$= [58° \text{ E of S}]$

$10\vec{V}_{12} = \sqrt{11.2^2 + 18^2}$

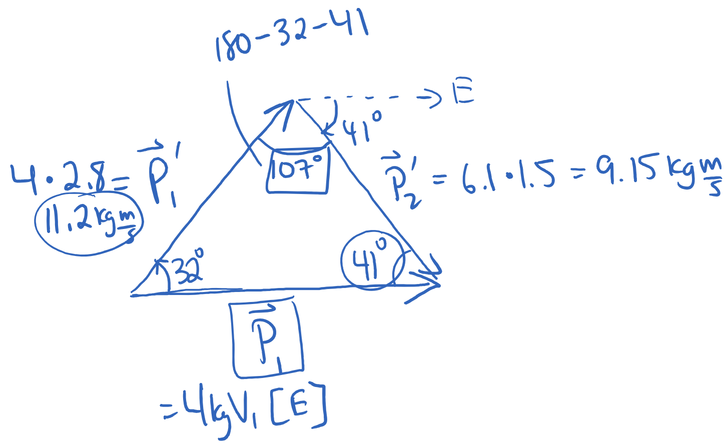
$\frac{10\vec{V}_{12}}{10} = \frac{21.2 \text{ kg}\frac{m}{s}}{10 \text{ kg}}$

$\vec{V}_{12} = 2.1 \frac{m}{s}$

example2

$\vec{P}_1 + \vec{P}_2^{\,0} = \vec{P}_1' + \vec{P}_2'$

↑ resultant (use vector addition)



Be cautious when using sine law to find angles. Sine law gives the smaller angle when sometimes you need 180-θ.

Find side $\vec{P}_1$ using sine law

$\frac{\vec{P}_1}{\sin 107°} = \frac{11.2}{\sin 41°}$

$\vec{P}_1 = 16.325685$ [E]

$= mV_1$

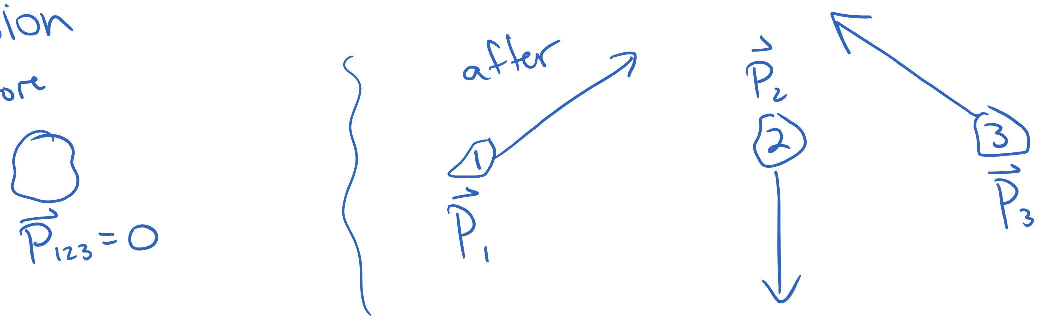
$4kg\,v_1 = 16.325685$

$v_1 = 4.1\ \frac{m}{s}\ [E]$

Example 3

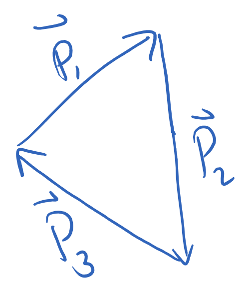
Explosion

before



$0 = \vec{p}_1 + \vec{p}_2 + \vec{p}_3$

draw equilibrium triangle since add to zero



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